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Capacity building for cassava clean seed production using the 250 m isolation distance in eastern Uganda

Faizo Kasule✉, Peter Wasswa, Anthony Okiror

ABSTRACT

Eastern Uganda is the largest producer of cassava in the country. However, cassava production in this region is greatly constrained by viral diseases causing food and income insecurities especially for smallholder farmers. Phytosanitation strategies such as clean cassava seed production at effective isolation distances can be employed to contribute to the management of viral diseases. To address the poor seed quality challenge, we provided capacity building to farmers, farmer groups and seed multipliers for cassava clean seed production using the 250 m effective isolation distance. These participants were selected from nine sub-counties in Bukedea and Kumi districts. Training involved lectures, field visits and practical establishment of cassava multiplication blocks. Overall, 250 farmers, 15 farmer groups and 30 seed multipliers in eastern Uganda were trained on the importance of 250 m isolation distance in the production of clean cassava planting materials. Furthermore, virus free tissue culture planting materials of NAROCASS 1, NASE 14 and NASE 03 cassava cultivars were disseminated to 18 seed multipliers to establish in their multiplication fields. This work will enhance productivity, incomes and food security of cassava farmers in eastern Uganda by managing both cassava brown streak disease and cassava mosaic disease.

Key words: Clean cassava planting materials, phytosanitation, seed multiplication, seed quality

1. INTRODUCTION

Cassava (*Manihot esculenta* Crantz) has been cultivated in sub Saharan Africa (SSA) for centuries and in this region, more than 800 million people benefit directly or indirectly from this crop (FAOSTAT, 2019). In SSA, cassava is ranked number one followed by yam and sweet potato. The Asian traders introduced cassava in Uganda between 1862 and 1875. The crop is adaptable, tolerant to drought and highly yielding under marginal conditions. As a result, cassava has been adopted and is currently grown in many parts of Uganda as one of the most important staple food crops with the eastern region being the leading producer with a yearly total output of 1.1 million metric tons (UBOS, 2017; FAOSTAT, 2019). Cassava is an important staple food crop cultivated by many smallholder farmers in eastern Uganda providing them with not only dietary carbohydrates

but also giving a good source of industrial raw material and substitute in animal feeds (UBOS, 2017; Nakabonge *et al.*, 2018; FAOSTAT, 2019).

Cassava production does not always meet demand of many smallholder farmers of eastern Uganda as it is constrained by several abiotic and biotic factors. Of the biotic factors, the two viral diseases, cassava brown streak disease (CBSD) and cassava mosaic disease (CMD), are a major constraint to cassava production in Uganda causing severe yield losses of 70-100% in turn threatening food and income security (Legg *et al.*, 2015). Cassava is vegetatively propagated and thus, the use of poor-quality cassava planting materials coupled with poor disease management practices has exacerbated the spread of major viral diseases in the country (Legg *et al.*, 2015; Kasule *et al.*, 2020ab). The cassava seed system in eastern Uganda is comprised of many smallholder farmers cyclically using field sourced planting materials of unknown virus status often obtained from own seed, friends, neighbors, community farmer organizations among others (Kasule *et al.*, 2020ab). This has contributed to the prevalence of both CBSD and CMD in the region where most cassava fields usually have both diseases on the same cassava plants. Therefore, management strategies require that both diseases be simultaneously controlled (Kawuki *et al.*, 2017).

Isolation distance of 250 m has been recommended to seed multipliers and inspectors for the effective production of clean cassava planting materials free of CBSD and CMD (Kasule *et al.*, 2020a). However, seed multiplication information using the 250 m effective isolation distance to produce clean planting materials is quite novel and needs to be relayed to the smallholder farmers, community farmer groups, seed multipliers, inspectors, extension workers among others. It was therefore important to create awareness on the importance of using this effective isolation distance in the production of clean planting materials to these different groups of eastern Uganda. Furthermore, virus free tissue cultured cassava seed were disseminated to these trained farmers, farmer groups and community seed multipliers and helped to establish multiplication blocks at 250 m isolation distance in their localities. This initiative will solve the challenge of poor-quality cassava seed in this region.

2. METHODOLOGY

2.1. Partner Institutions

Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) and Makerere University Agricultural Research Institute, Kabanyolo (MUARIK) Tissue Culture Laboratory were involved in this work

2.2. Study area

This study was conducted in Bukedea and Kumi districts of eastern Uganda. Bukedea is located between latitudes 1°20'30.60"N and longitudes 34°02'24"E and Kumi is located between latitudes 1°27'38"N and longitudes 33°56'10"E.

2.3. Sampling frame

The two districts were purposely selected because they are dominantly cassava-growing areas in the region. This study targeted farmers, farmer groups and seed multipliers involved in the cassava seed system of eastern Uganda, therefore purposive simple random sampling was used taking at least 25 farmers from each sub county. A total of 250 farmers, 15 farmer groups and 30 seed multipliers were chosen from five sub-counties of Bukedea district namely; Malera, Kabarwa, Kidongole, Koena and Kocheke and from four sub-counties of Kumi district namely; Ongino, Kumi, Kanyum and Ngero.

2.4. Sensitization of participants on the importance of 250 m isolation distance in the production of clean cassava planting materials

The training program was executed at farmer localities, meeting places for the different farmer organizations and sometimes at the sub-county. Nine training workshops were held in eastern Uganda. All the nine sub-counties of both Bukedea and Kumi districts were intended to benefit from this training. The trained farmers, farmer groups and seed multipliers were to be tasked to train other farmers in the region.

Further training for selected seed multipliers and community farmer groups involved visits to selected farmer locations and practical demonstrations were held to ensure the different groups were capable of establishing multiplication blocks at 250 m isolation distance. The trainees were equipped with both theoretical and practical knowledge and skills for preparing and handling tissue culture plants for acclimatization and multiplication at 250 m isolation distance. The training also involved sensitizing farmers on the symptoms of CBSD and CMD using printed sheets that had pictures of affected plants.

2.5. Cassava seed production to disseminate to seed multipliers

Virus free plantlets NAROCASS 1, NASE 14 and NASE 03 cassava cultivars were obtained from the MUARIK Tissue Culture Laboratory. These plantlets were part of the materials used by Kasule *et al.* (2020a), and were maintained carefully on tissue culture media. NAROCASS 1 is CBSD tolerant, CMD resistant and high yielding (Mukiibi *et al.*, 2019) while NASE 03 and NASE 14 are the most preferred cassava cultivars in eastern Uganda, yet susceptible to *cassava brown streak viruses* (CBSVs) and *cassava mosaic begomoviruses* (CMBs) which cause CBSD and CMD respectively (Kasule *et al.*, 2020b). The plantlets were weaned and grown in pots under strict quarantine conditions in a screen house for 2 months while observing for CBSD and CMD symptoms. Mini set cuttings were used to further multiply these plantlets (still in a screen house) to eventually generate 3500 virus free plantlets of each cultivar (NAROCASS 1, NASE 14 and NASE 03). These plantlets were taken to the farmers during March 2021 ready for planting in Bukedea and Kumi districts in the fields of the selected seed multipliers at the onset of rains.

2.6. Seed dissemination

Eighteen seed multipliers were selected from Malera, Kabarwa, Kidongole, Bukedea, Koena and Kocheke sub-counties of Bukedea district while others were sourced from Ongino, Kumi, Kanyum and Ngero sub-counties of Kumi district, to multiply cassava seed in Bukedea and Kumi districts. The selected participants had their multiplication fields located in areas that were at least 250 m from other neighboring cassava fields to prevent CBSVs and CMBs viral spread. Each seed multiplier was given virus free plants of each cultivar (NAROCASS 1, NASE 14 and NASE 03) to establish in their multiplication fields with the assistance of our team. Follow up was done to inspect the established multiplication blocks of these selected seed multipliers.

3. RESULTS

3.1. Achievements

Through careful selection of participants, we managed to train farmers, community farmer groups and seed multipliers on how effective isolation distances can be employed to produce clean cassava planting materials (Plate 1, 2, 3).



Plate 1. Capacity building training on cassava clean production for members of Popular Knowledge Women's Initiative (PKWI) in Bukedea district



Plate 2. Sensitizing farmers and seed multipliers from Ngero sub-county, Kumi district on management of major viral diseases in cassava, the use of clean planting materials, seed selection, seed multiplication at effective isolation distance among others

A total of 250 farmers, 15 farmer groups and 30 seed multipliers of eastern Uganda were trained and sensitized on the importance of 250 m isolation distance in the production of clean cassava planting materials. The trained representatives were able to acquire this knowledge and can transmit it to other farmers in surrounding areas who did not participate in this training hence increasing the number of knowledgeable stakeholders.

Secondly, after training, eighteen community seed multipliers from nine sub-counties of eastern Uganda with enough land to carry out seed multiplication at the 250 m effective isolation distance were identified and successfully given 11000 virus-free tissue culture plants for the first field multiplication cycle (Table 1). Up to now, the different sub-counties of Bukedea and Kumi districts of eastern Uganda had no access to high quality virus-tested planting material to use in their multiplication blocks as stock material.

Table 1. Number of plantlets per cultivar disseminated to community farmer seed multipliers in nine sub-counties of eastern Uganda

Bukedea sub-counties	Number of plants per cultivar		
	NASE 03	NASE 14	NAROCASS 1
Malera	400	420	410
Kabarwa	400	400	400
Kidongole	406	404	410
Koena	410	400	400
Kocheka	400	420	410
Kumi subcounties			
Ongino	410	400	410
Kanyum	400	420	410
Kumi	400	420	410
Ngero	400	410	420



Plate 3. Mr. Kasule Faizo showing farmers clean tissue culture cassava planting materials they are supposed to plant in the multiplication blocks at 250 m isolation distance. This was during the training with farmers in Malera sub-county, Bukedea district

3.2. Challenges identified and way forward

Inadequate extension services especially on cassava seed production and dissemination

The extension workers are supposed to provide advisory services to the farmers on; the application of scientific research and new knowledge to agricultural practices through farmer education. However, many of them are unavailable to farmers. This was witnessed when the extension workers failed to turn up for our training after sending out invitation requests.

Lack of clear source of clean planting material for farmers most especially the foundation seed

Almost every home in Bukedea and Kumi grows cassava but no system had been put in place in this region to efficiently regulate the production and dissemination of quality/certified cassava planting materials. The available screen houses are in very poor condition and poorly managed (Plate 4). There is need to train the nursery operators on proper screen house management.

Need for virus free local varieties

We focused on NAROCASS 1, NASE 14 and NASE 03 since they are the most preferred cassava cultivars in Bukedea and Kumi districts. However, farmers have other local varieties like York, Bukalasa among others that may need cleaning and multiplication. We recommend virus elimination and production of tissue culture plantlets of such local varieties.

Limited sample size for the sensitized cassava stakeholders of eastern Uganda

Only 250 farmers, 30 seed multipliers and 15 farmer groups were trained from the different sub-counties of Bukedea and Kumi districts. We learnt that there is need to train more farmers, farmer groups and seed multipliers from surrounding districts like Amuria, Soroti, Ngora and Serere.



Plate 4. The inside of the poorly managed cassava screen house for PKWI in Bukedea district.

Extremely hot conditions

Bukedea and Kumi districts have extremely hot conditions. High temperatures may destroy tissue culture (TC) plants if planted in this area. A solar water pump to frequently provide water to supplement on the stored rainwater is needed for one to establish TC plantlets in this region.

Land limitation

For small-scale farmers in eastern Uganda that have limited land, the effective 250 m isolation distance would be a constraint limiting many farmers to do cassava seed multiplication given the challenge of land fragmentation in Uganda. This was witnessed when we were selecting the 18 community seed multipliers from nine sub-counties. Due to lack of enough land, seed multipliers were advised to collectively do seed multiplication in the same community/locality in order to avoid CBSV and CMV infections from neighboring farmer cassava fields that are not involved in seed production.

4. DISCUSSION

At the time of initiating this capacity building, seed multiplication information to produce clean planting materials at the 250 m effective isolation distance was quite novel and news to the many smallholder farmers, community farmer groups and seed multipliers of eastern Uganda. Therefore, capacity building through training of cassava stakeholders in Bukedea and Kumi districts of eastern Uganda helped to create awareness on how to produce of clean cassava planting materials at the 250 m isolation distance. Trainings like these are vital in combating cassava viral diseases through maintaining the use of clean planting materials.

In addition to capacity building, the training encouraged and promoted the use CMD resistant and CBSV tolerant cultivars like NAROCASS 1. This cultivar is not only disease tolerant but also high yielding (Mukiibi *et al.*, 2019). The seed multipliers in eastern Uganda were provided with virus free TC plants of NASE 14 and NASE 03 (preferred cassava cultivars in eastern Uganda, Kasule *et al.*, 2020 b) and NAROCASS 1 cultivar. A number of multiplication sites were established in Bukedea and Kumi districts of eastern Uganda to produce clean cassava planting materials of NAROCASS 1, NASE 14 and NASE 03 cultivars to address the challenge of seed quality by controlling the movement of diseased cassava planting materials in the region.

While shorter distances may not be effective, the 250 m isolation distance is effective but would pose a constraint to small-scale and land limited farmers given the challenge of land fragmentation in Uganda. Therefore, community phytosanitation strategy was suggested in Bukedea and Kumi districts selected from eastern Uganda. Due to lack of enough land, seed multipliers were advised to do seed multiplication in the same community/locality in order to avoid CBSV and CMV infections from neighboring farmer cassava fields that are not involved in seed production.

The established cassava multiplied blocks at 250 m isolation distances are to provide clean cassava planting materials to the smallholder farmers in the region and these blocks are always inspected by the trained cassava seed inspectors and extension workers. This will reduce on the act of cyclic propagation cassava planting materials by these farmers hence managing CBD and CMD in eastern Uganda. However, complete prevention of the use diseased planting materials and the spread of CBD and CMD may take some time as the districts neighboring Bukedea and Kumi use cyclic propagation, which may draw some of the trained farmers to use the diseased cuttings, as they are easy to obtain. Trained smallholder farmers need to be fully committed to the use of clean planting materials. In addition, the local governments of Bukedea and Kumi districts and international communities need to support ongoing and emerging development research efforts in order to have a vibrant cassava seed system in eastern Uganda dominated by the use of clean planting materials to address the challenge of seed quality due to major viral diseases.

5. CONCLUSION

The implemented capacity building on using the 250 m isolation distance for clean cassava seed production in eastern Uganda significantly increased awareness among smallholder farmers, community farmer groups and seed multipliers within and between sub-counties of Bukedea and Kumi districts in the eastern agro-ecological zone of Uganda on how to combat CBD and CMD.

Furthermore, virus free tissue culture planting materials of NAROCASS 1, NASE 14 and NASE 03-cassava cultivars were disseminated to 18 seed multipliers to establish in their multiplication fields. This work is anticipated to improve production, income and food security for cassava farmers in eastern Uganda by managing cassava brown streak disease and cassava mosaic disease.

Conflict of interest

The authors declare that they have no conflict of interest.

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Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Data and materials availability

All data associated with this study are present in the paper.

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